

# Research projects and coordination in Japan toward CMIP6

Michio Kawamiya

Director

Department of Integrated Climate Change Projection Research (ICliP)

Japan Agency for Marine-earth Science and Technology  
(JAMSTEC)



**SOUSEI** Program for Risk Information  
on Climate Change

気候変動リスク情報創生プログラム

FY 2012-2016

Budget: ~7m\$/y

**A. Prediction and diagnosis of imminent global climate change (PI: M. Kimoto, U. of Tokyo)**

*D/A, E/A, Seamless Prediction, Climate Sensitivity, Data Assimilation*

**B. Climate change projection contributing to stabilization target setting (PI: M. Kawamiya, JAMSTEC)**

*Climate Scenario, Earth System Model, Tipping Element, Geo-engineering*

**C. Development of basic technology for risk information on climate change (PI: I. Takayabu, MRI)**

*Dynamical and Statistical Downscaling, High-res GCM*

**D. Precise impact assessments on climate change (PI: E. Nakakita, Kyoto U.)**

*Weather, Water, Coastal Disasters, Water Resource, ecosystem ...*

**E. Promotion office for climate change research and linkage coordination (PI: M. Kawamiya, JAMSTEC)**

Supported by MEXT



文部科学省

MINISTRY OF EDUCATION,  
CULTURE, SPORTS,  
SCIENCE AND TECHNOLOGY-JAPAN

# Earth Simulator and the K(京) Computer

	Total Peak Performance (Pflops)	Total main memory (Tbyte)	Peak Performance / CPU (Gflops)	Total number of CPUs
Earth Simulator III (JAMSTEC)	1.31	328	256 (4 cores)	5120
K Computer (Riken)	10.6	1,260	128 (16x8cores)	88,128



Earth Simulator III: “medium” size simulations such as CMIP experiments. Operation starts this March.

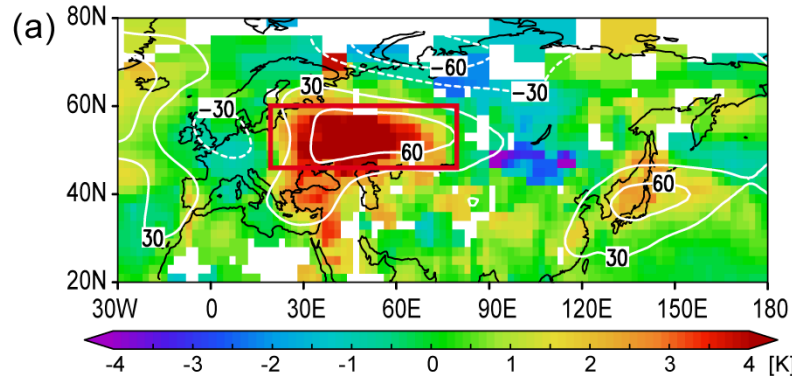


K Computer: ambitious, gigantic size simulations such as global cloud resolving runs with 870m mesh

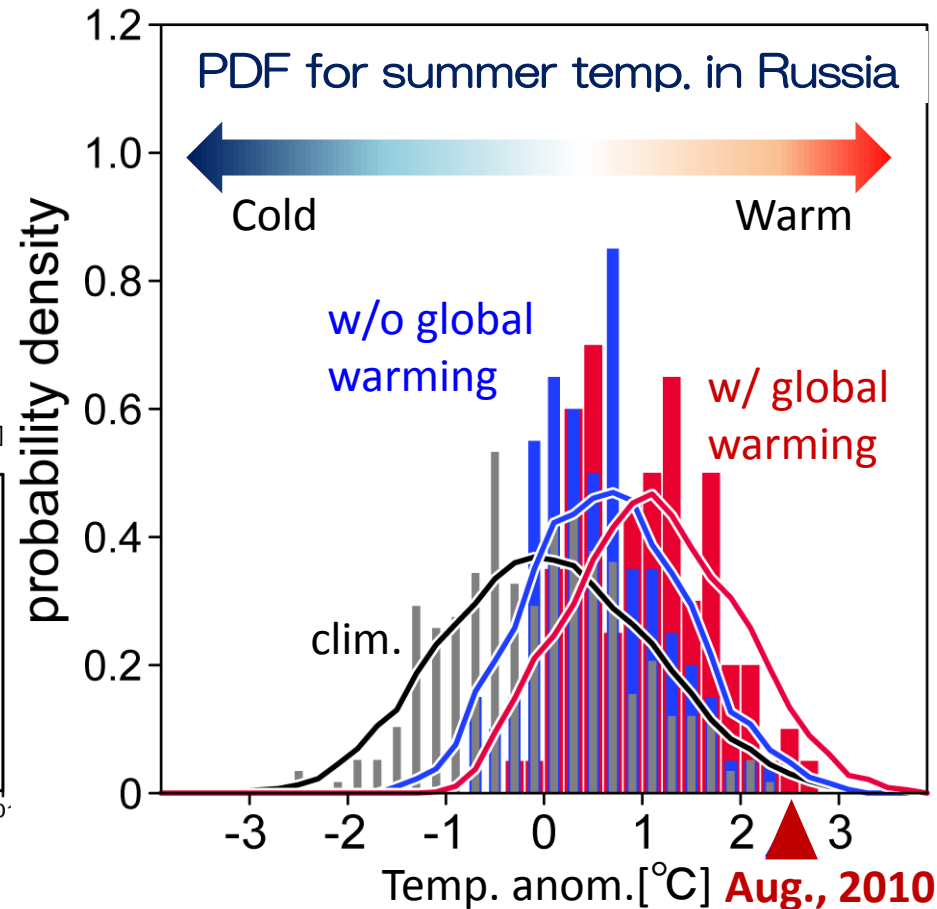
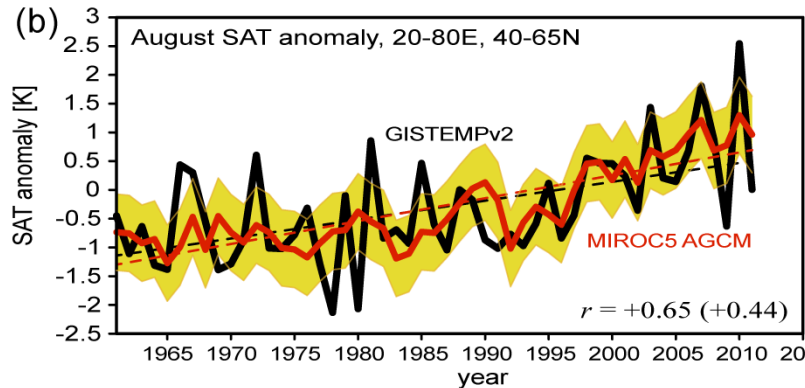
# Event attribution for Russian heat wave, 2010

Surface temperature anomaly for Aug., 2010

**Obs.  
(2010)**



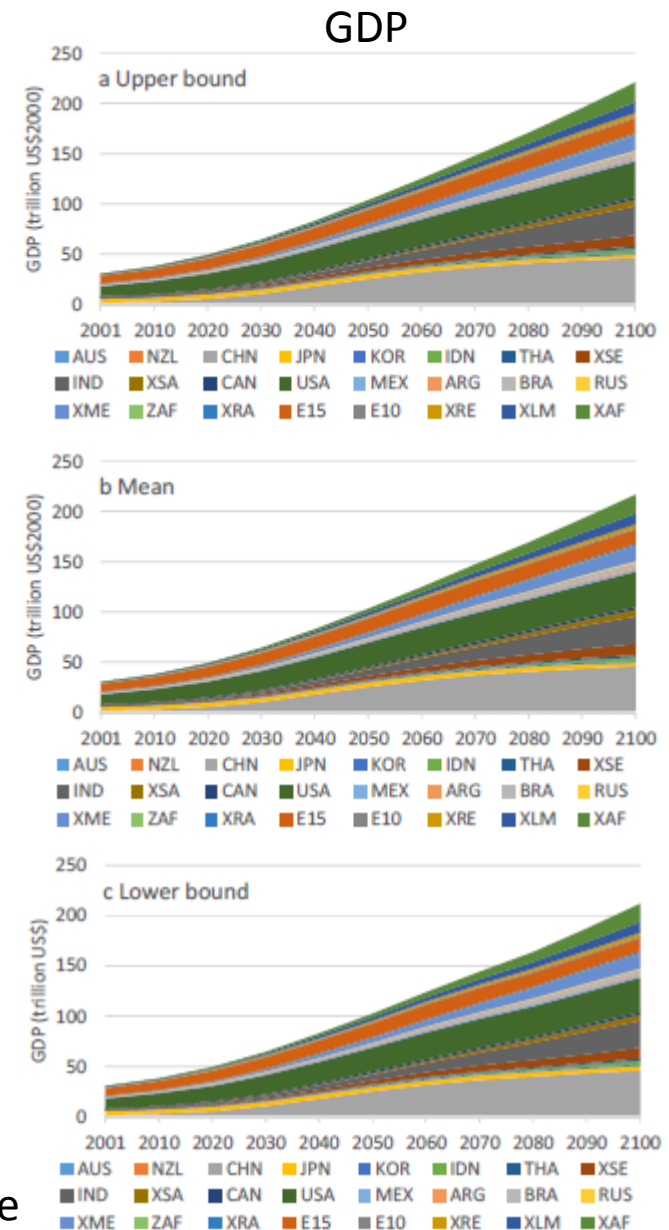
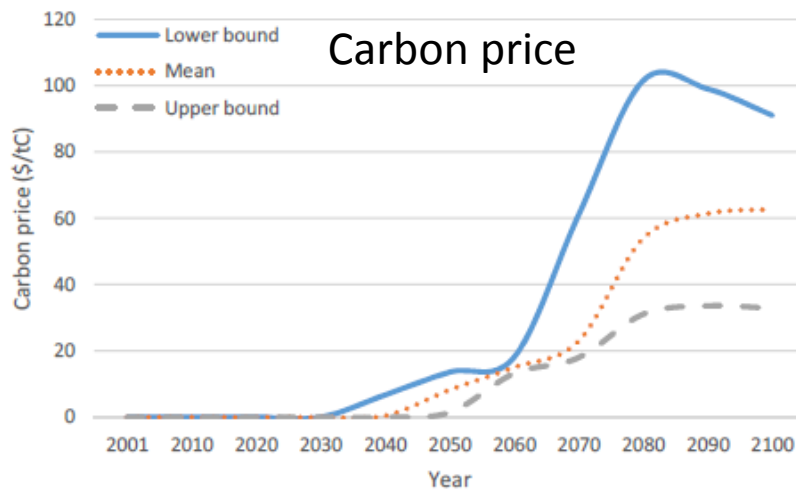
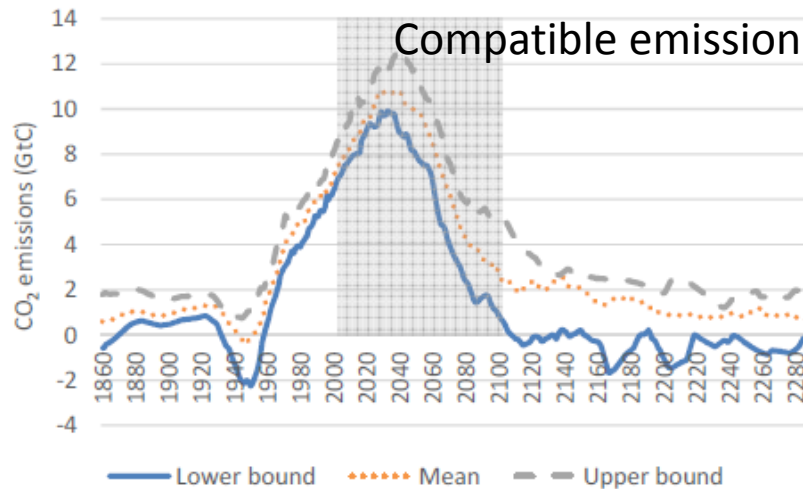
**Model**



Observed heat wave is—

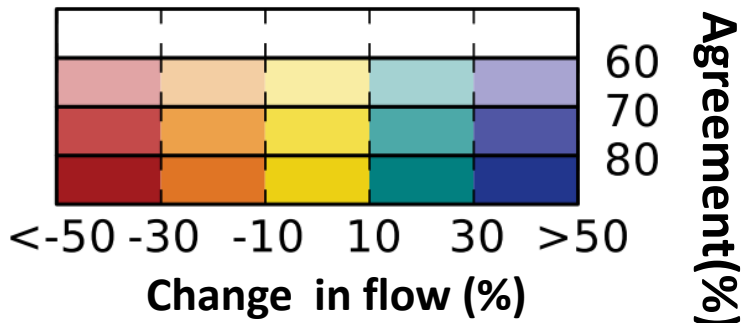
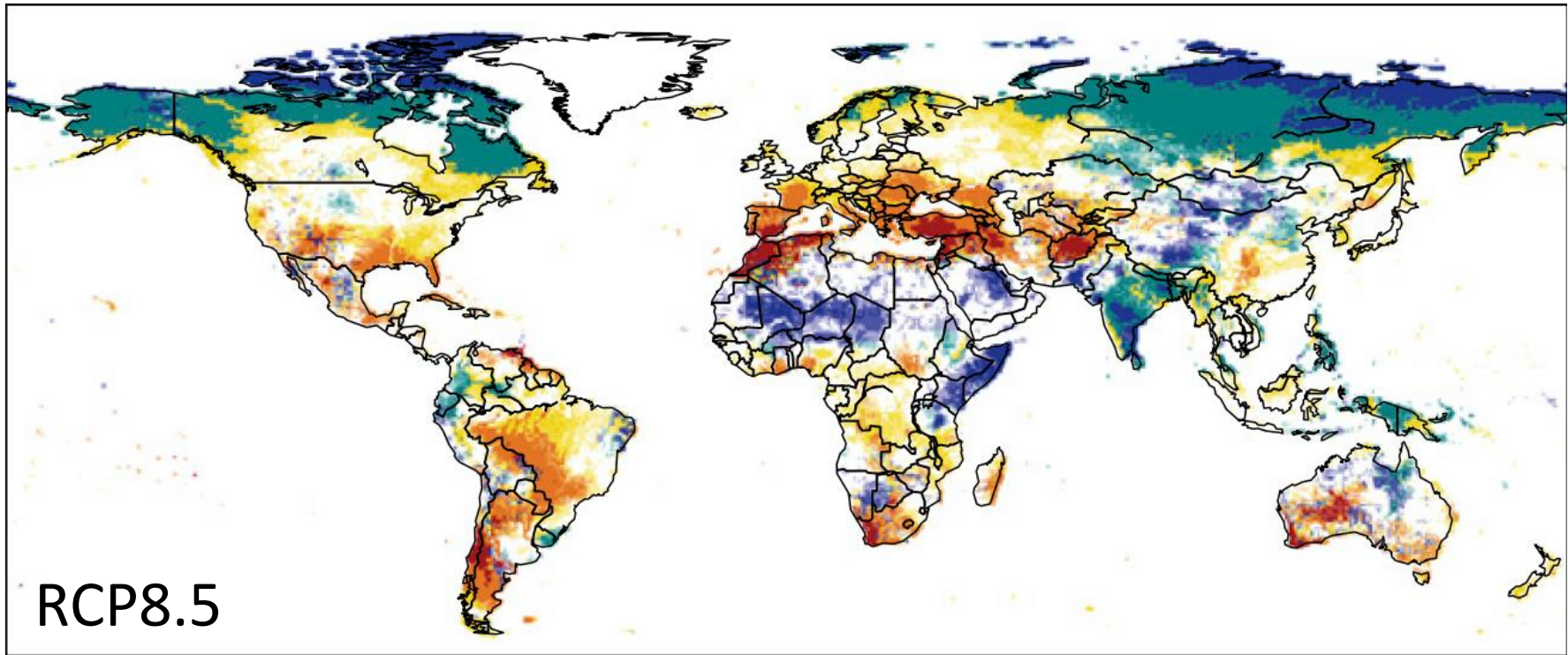
- mostly natural variation in terms of amplitude
- in terms of probability, probability of occurrence of such heat wave is extremely low w/o global warming

# Socio-economic scenarios corresponding to RCP4.5 concentration scenario calculated by MIROC-ESM (Matsumoto et al., submitted)



Uncertainty in socio-economics accompanying RCP4.5 → Large impact on carbon price, significant (4%) difference in GDP

# Changes in annual mean river flow (2°C warming case)



Based on 5GCMs × 12 hydrological models:

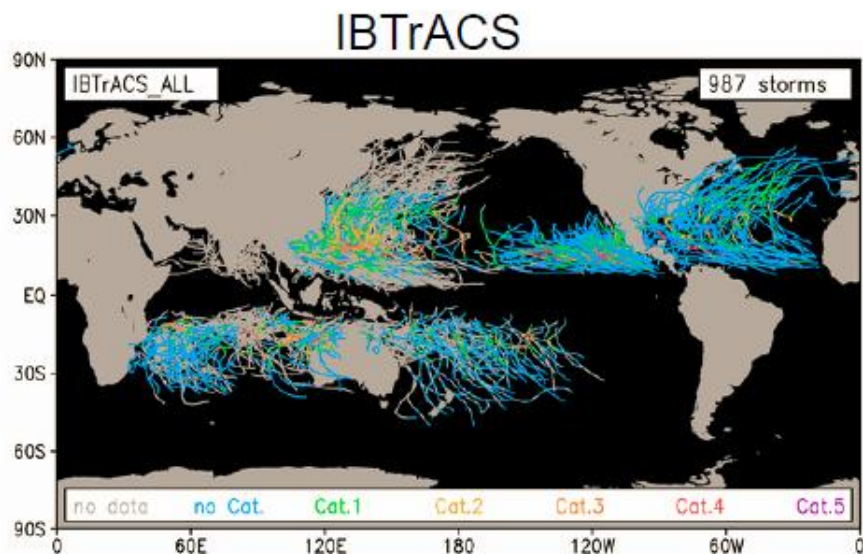
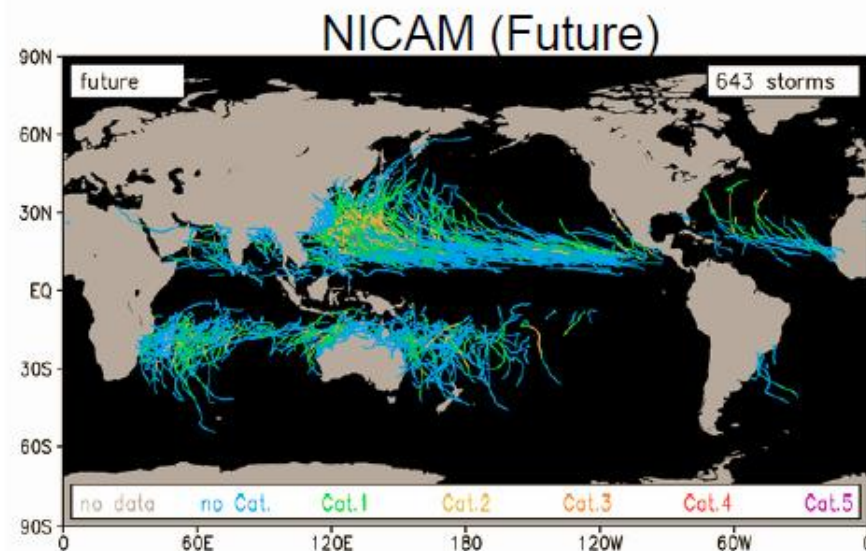
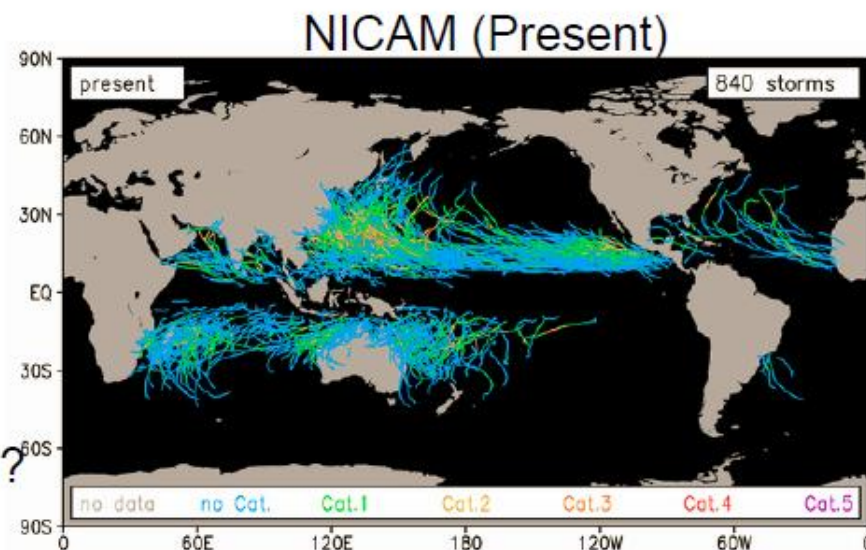
- Changes in river flow
- Their uncertainty are evaluated.



# NICAM for HighresMIP?

## Global non-hydrostatic model (NICAM) simulation

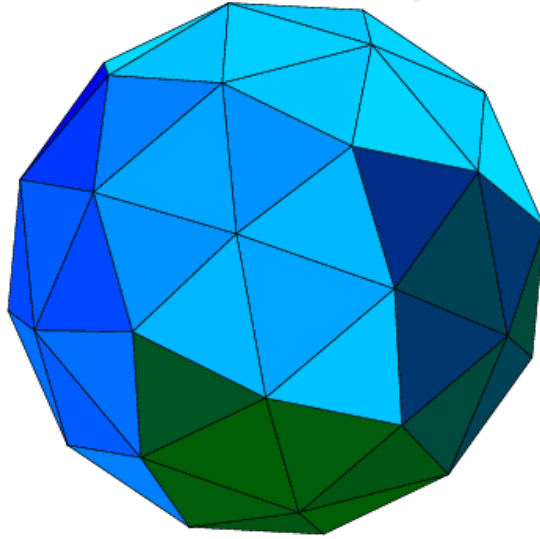
- 9yr runs w/ 14km resolution
- Frequency -23%
- Intensity +2.2%
- Within the range of current estimate,  
but could it tell us change in the genesis?



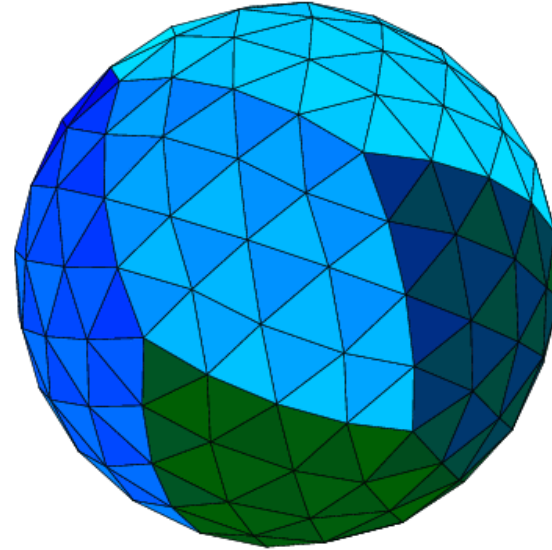
Courtesy of Y Yamada

# Grid system for NICAM (Non-hydrostatic Icosahedral Atmospheric Model)

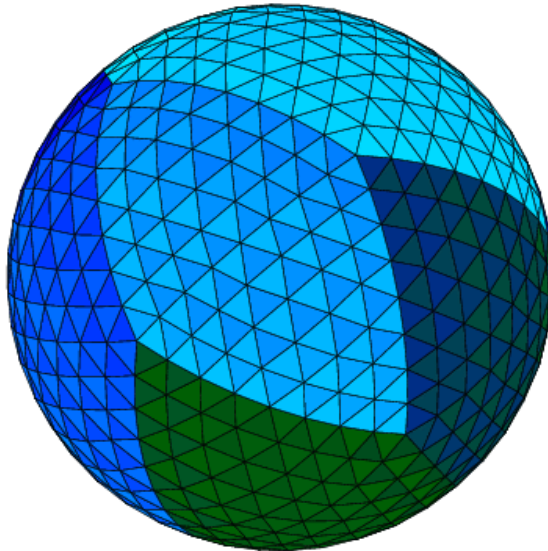
**G-level 1 (one-time division)**



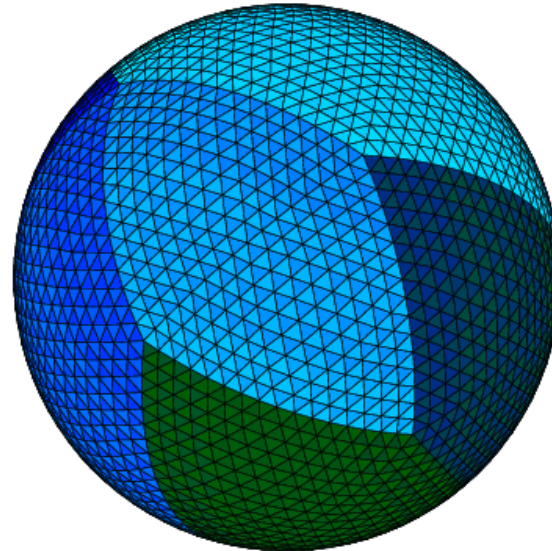
**G-level 2**



**G-level 3**



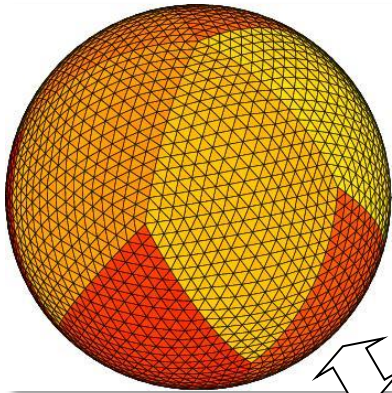
**G-level 4**



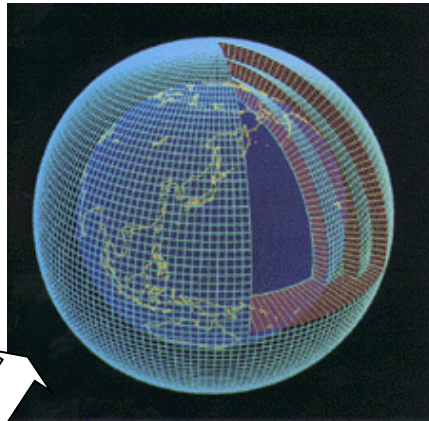


# Coupling software development: Jcup

Icosahedral model (NICAM)



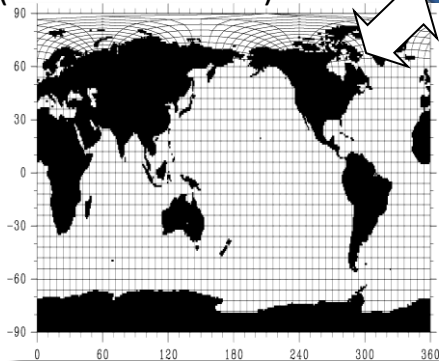
Spectral model (MRI, MIROC)



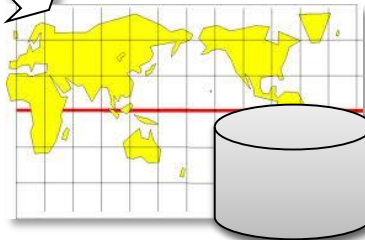
Common coupling  
Layer

Coupling  
library (Jcup)

Tri-pole ocean model  
(COCO for MIROC)



IO component  
(generic grid systems -> lat.-lon. System)



## Jcup:

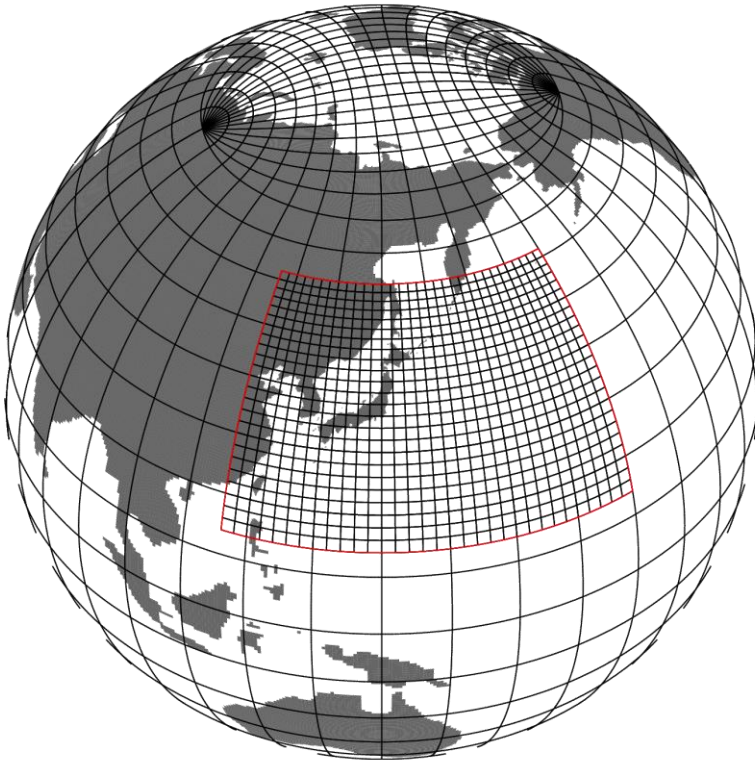
- coupling software for facilitating data transfer among various component model
- aiming eventually at establishing a common environment for climate model development

## Nesting

Goal:  $0.1^\circ$  global COCO +  $0.02^\circ$  regional model around Japan

● Now under development with lower resolution (panels below)

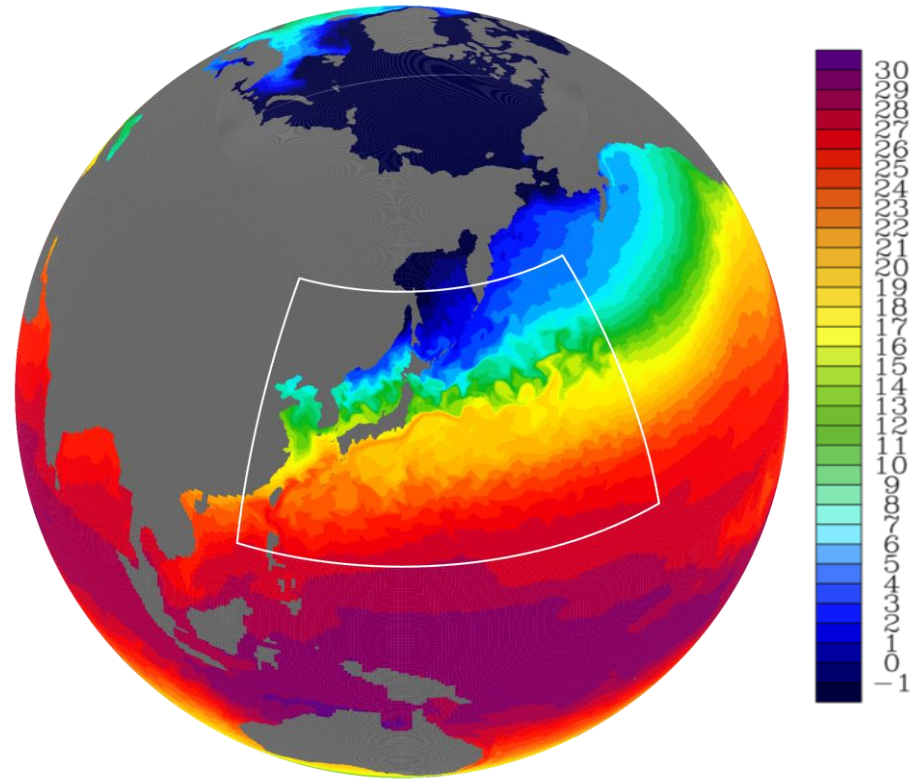
( $0.02^\circ$  nesting has been realized under triple nesting )



Tripolar grid + 5x resolution around Japan

Outer model :  $0.5^\circ \times 0.5^\circ \cos\theta$

Inner model :  $0.1^\circ \times 0.1^\circ \cos\theta$

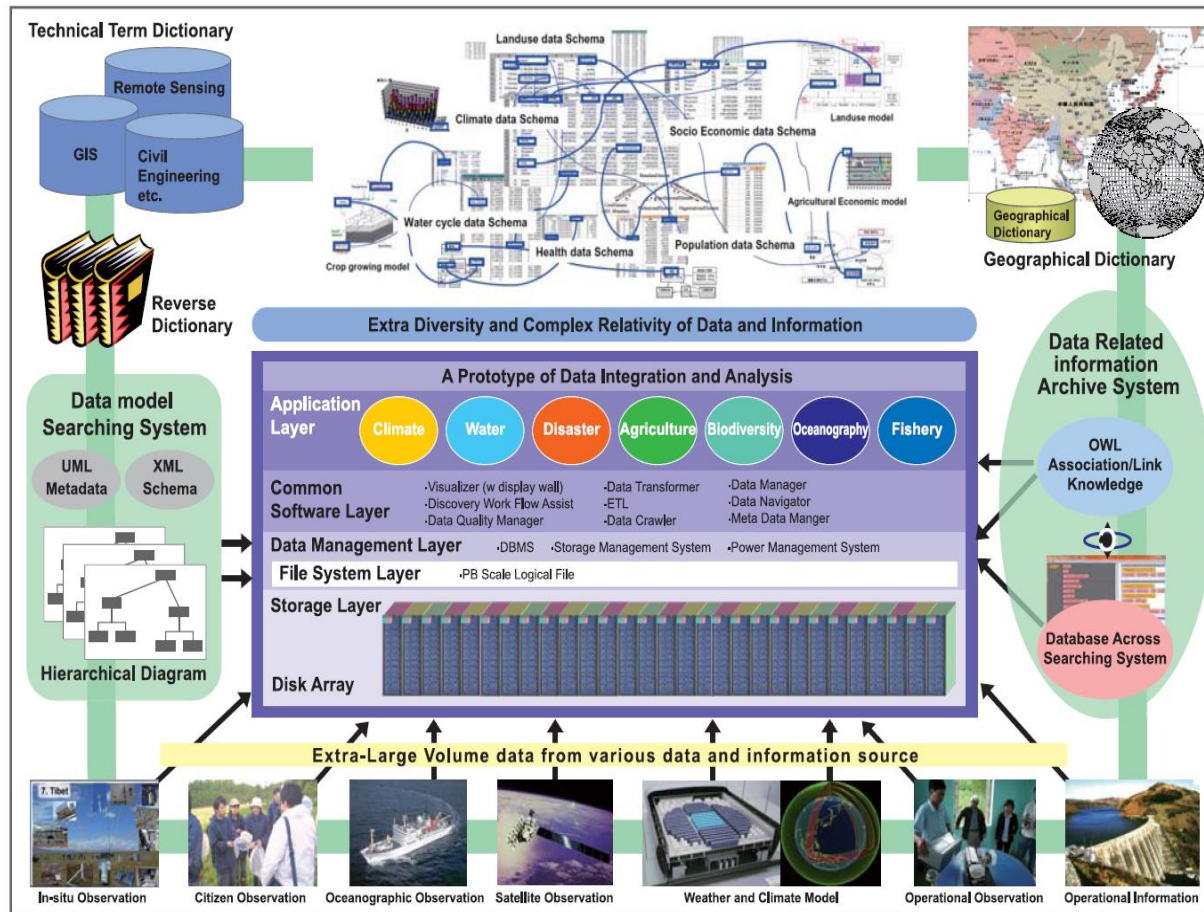


SST snapshot

# Data Integration and Analysis System

*a legacy for Japan's contributions to GEOSS*

To create knowledge enabling us to solve the Earth environment problems and to generate socio-economic benefits,

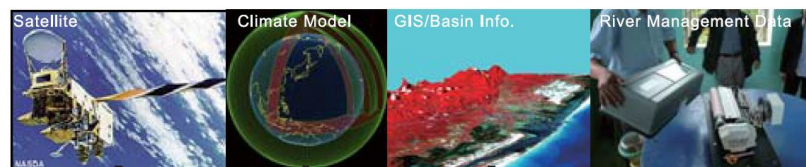




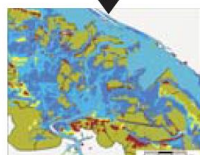
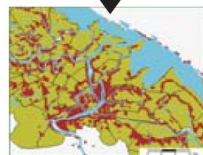
# Data Integration and Analysis System

*a legacy for Japan's contributions to GEOSS*

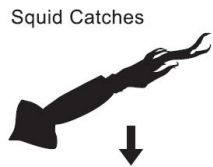
enabling us to do **integrated research** and  
to realize **inter-disciplinarity**



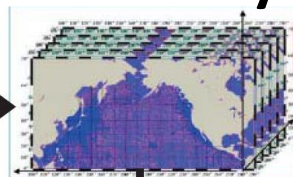
**DIAS**



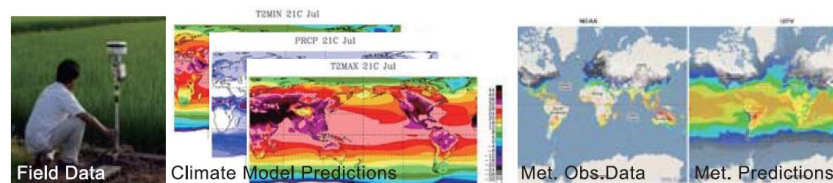
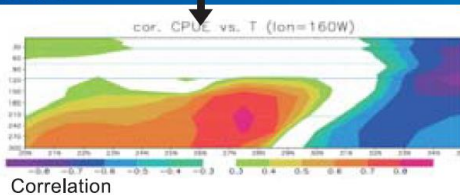
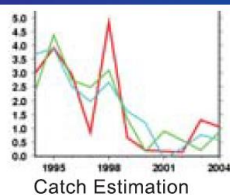
**Water**  
**Fishery**  
**Climate**



Squid Catches



**DIAS**



**DIAS**



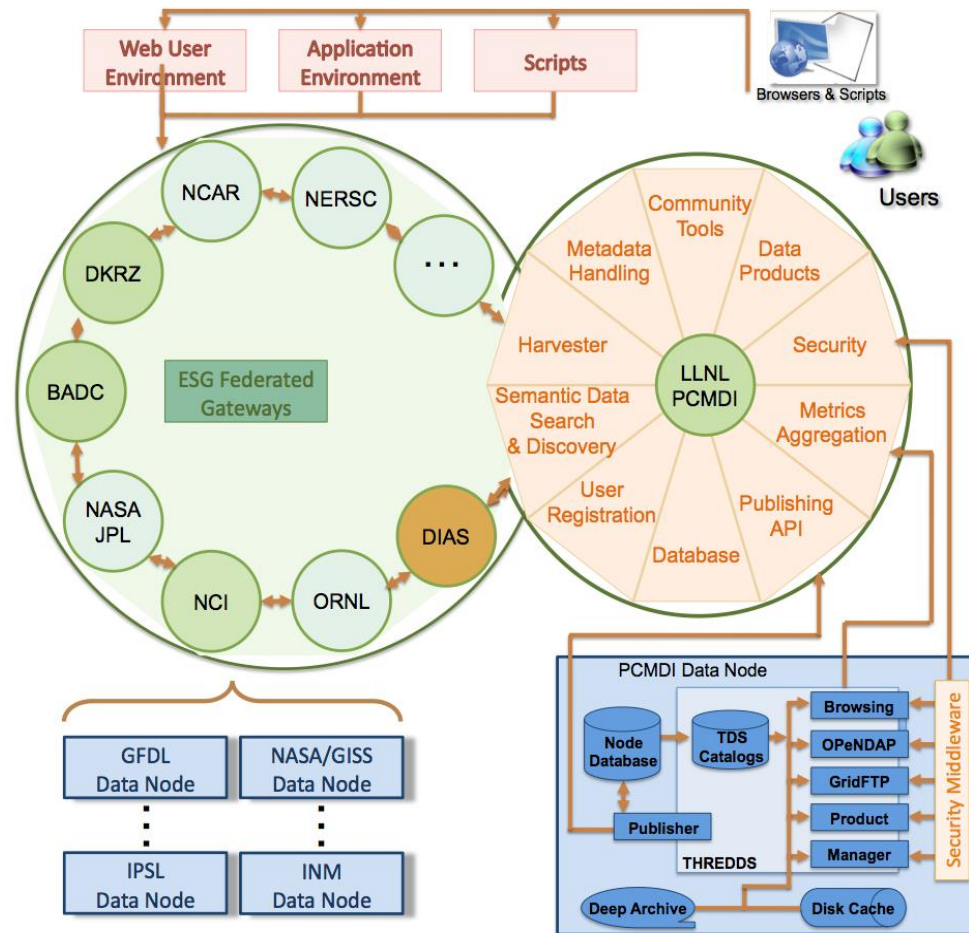
**Food**  
**Biodiversity**



**DIAS**



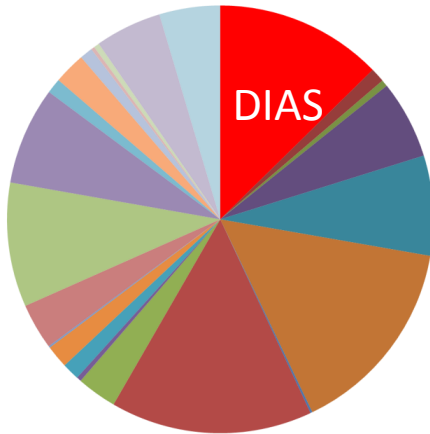
# Earth System Grid: global system for CMIP5 data distribution



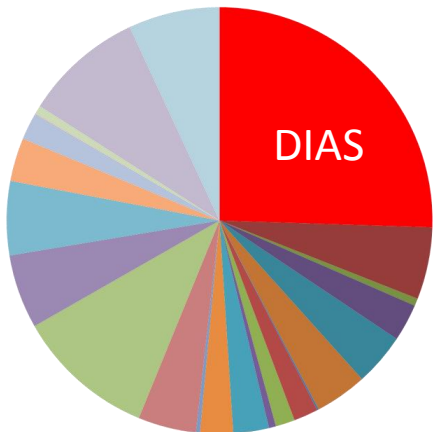


# DIAS stats

Original data stored  
in each data nodes



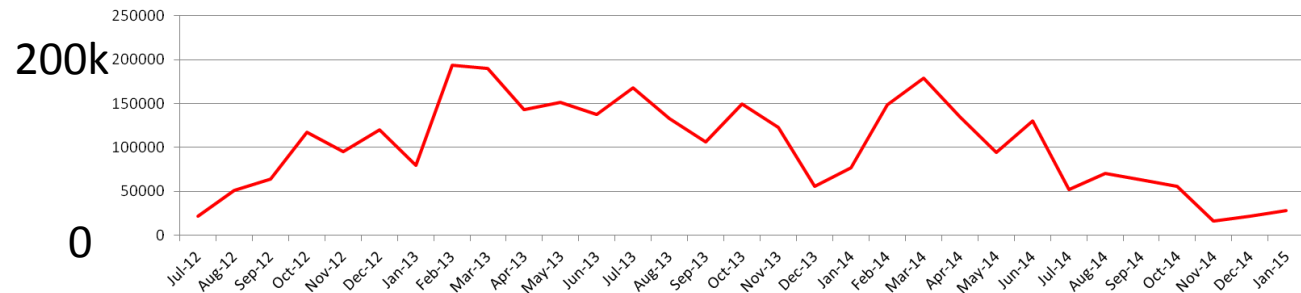
#datasets



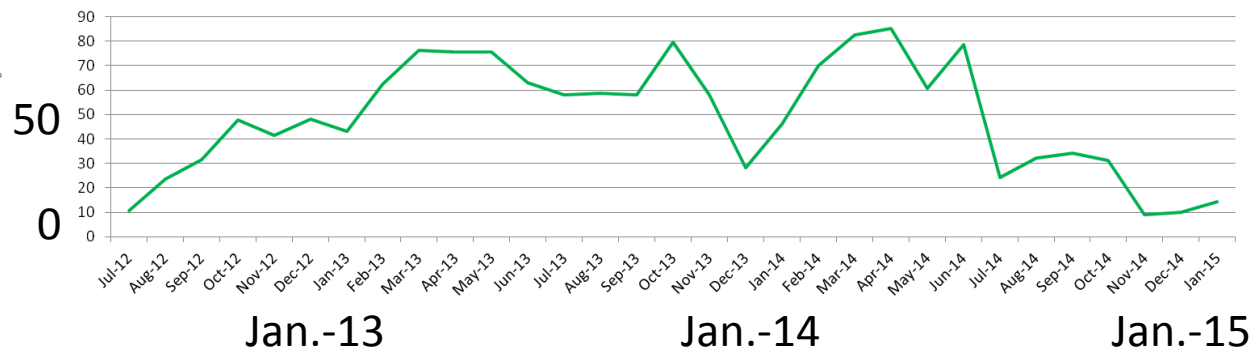
Data amount

- dias-esg-nd.fki.iis.u-tokyo.ac.jp
- adm07.cmcc.it
- aim3.llnl.gov
- bccsm.cma.gov.cn
- bmbf-ipcc-ar5.dkrz.de
- cmip5.fio.org.cn
- dapp2p.ccmma.ec.gc.ca
- esg-dn1.nsc.liu.se
- esg.bnu.edu.cn
- esg.cnrm-game-meteo.fr
- esg.fang.ac.cn
- esg01.nersc.gov
- esg2.e-inis.ie
- esgdata.gfdl.noaa.gov
- esgdata1.ncsc.nasa.gov
- esgf.extra.cea.fr
- esgnode2.nci.org.au
- noreg.norstore.uio.no
- pcmdi7.llnl.gov
- pcmdi9.llnl.gov
- tds.ucar.edu
- vesg.ipsl.fr

Number Downloads



Downloaded Data (TBytes)

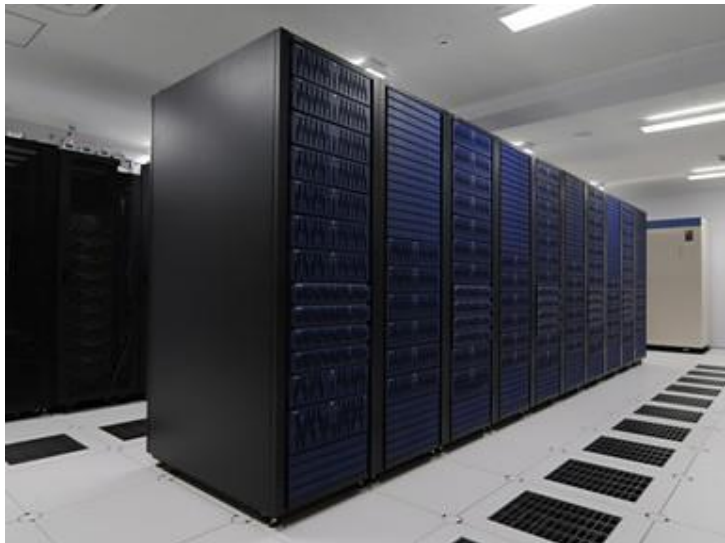


# Data Integration and Analysis System

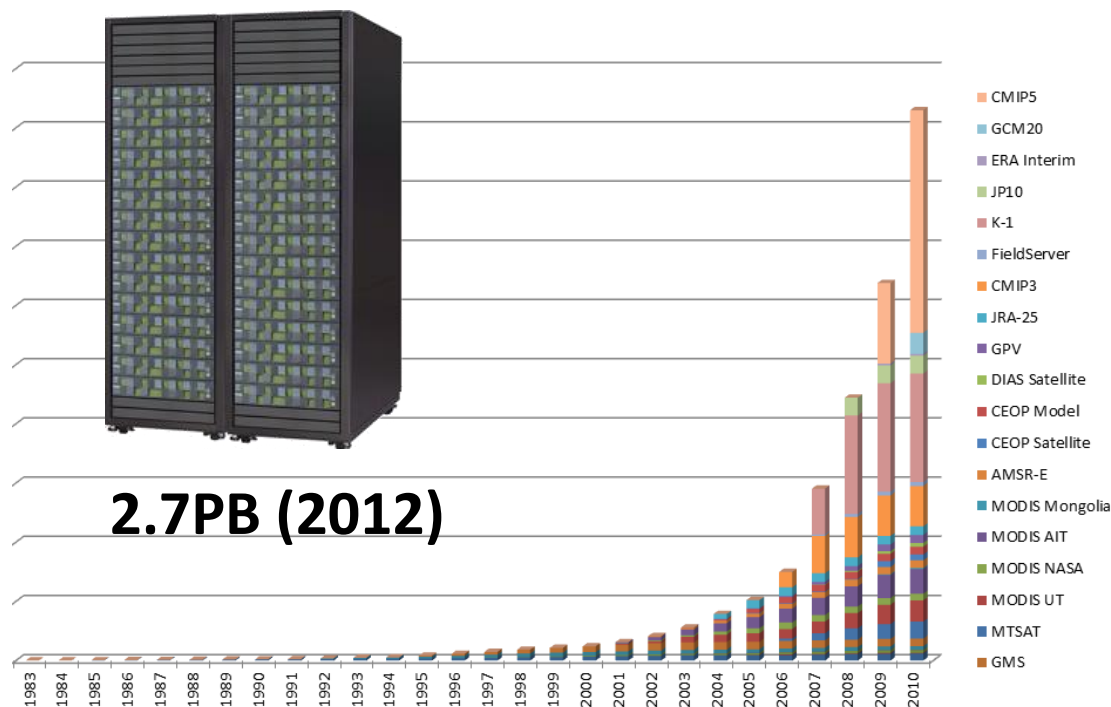
*a legacy for Japan's contributions to GEOSS*

**tackling a large increase in **volume** of the Earth observation data.**

**CMIP3 for AR4 (2007): 40TB → CMIP6 for AR5 (2012): 2.6PB**



## 600TB (2007)

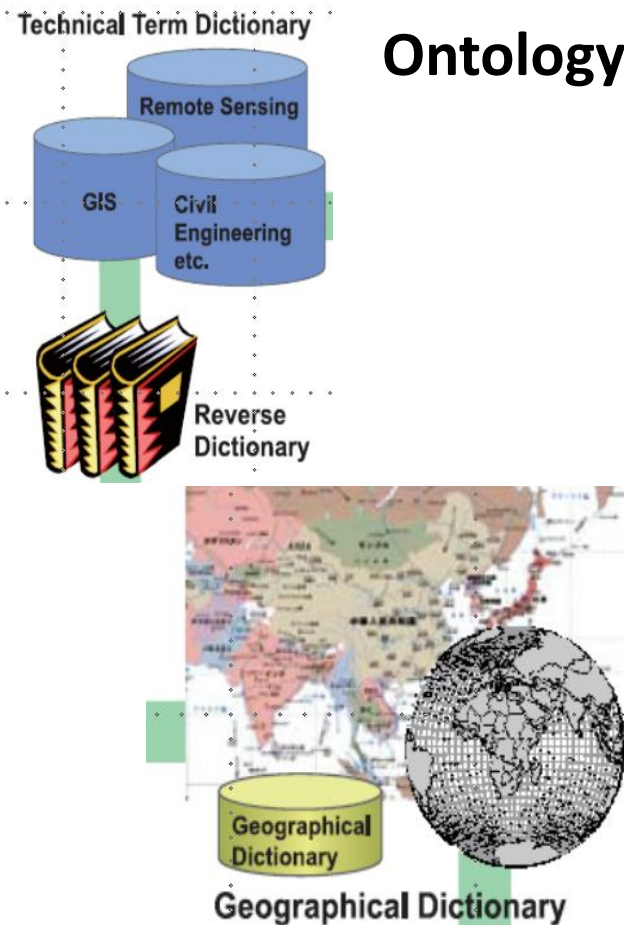


# Data Integration and Analysis System

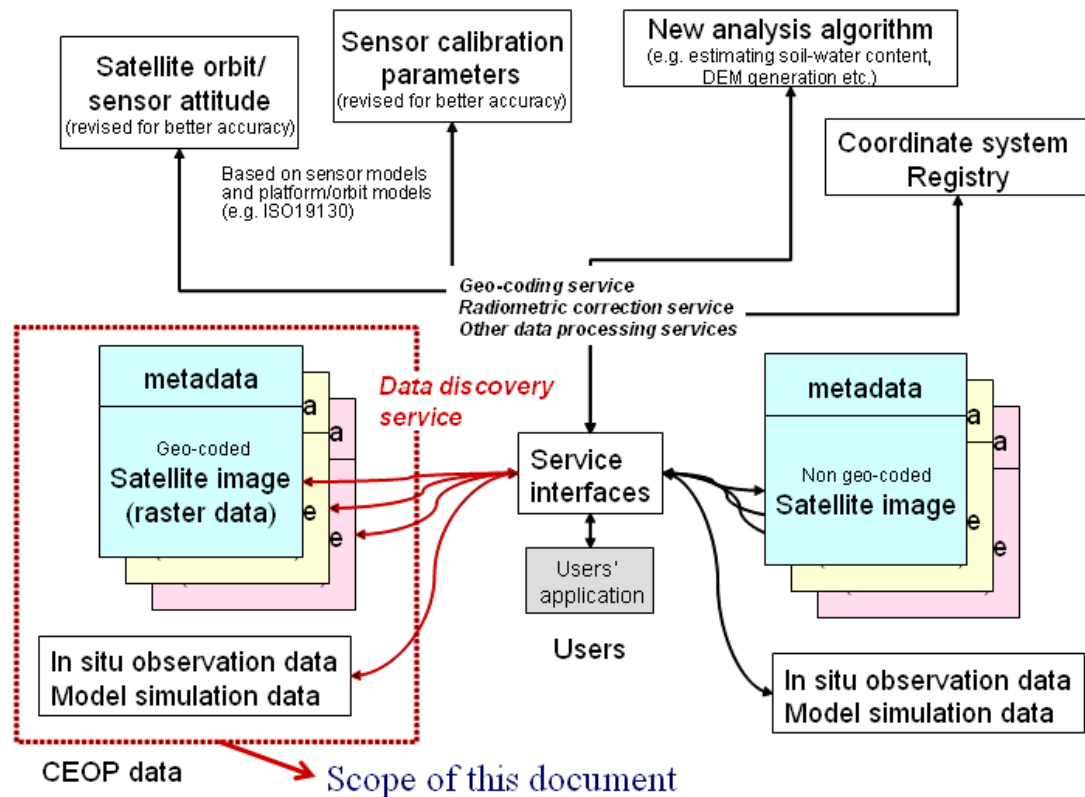
*a legacy for Japan's contributions to GEOSS*

tackling a large increase in **diversity** of the Earth observation data.

## Ontology




## Meta data Design



# Data Integration and Analysis System

*a legacy for Japan's contributions to GEOSS*

enriching data **searching** capability



**データ俯瞰・検索システム (β)**  
A Search and Discovery System for DIAS Datasets

日本語

---

[Home](#)
[How to use](#)
[What's New](#)
[About](#)

**What?**

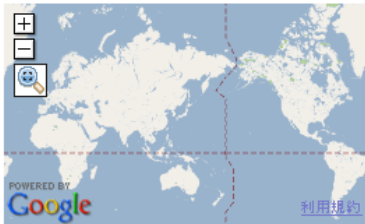
All:

Title:

Contact info.:

Abstract:

**Where?**



N

W   E

S  ☒ Global

☐ overlaps ☒ encloses

POWERED BY Google

**When?**

From

☐ Use this condition

To

☐ Use this condition

☐ overlaps ☒ between dates

---

Vertical axis

Horizontal axis

# of dataset titles displayed

☐ Visible empty category

		GCMD Platforms					
		Earth Observation Satellites	In Situ Land-based Platforms	In Situ Ocean-based Platforms	Maps / Charts / Photographs	Models	Undefined
GCMD Science Keywords	Agriculture		[ 34 ]			[ 27 ]	
	Atmosphere	[ 30 ]	[ 6 ]	[ 1 ]		[ 32 ]	
	Biological Classification		[ 1 ]				
	Biosphere	[ 2 ]	[ 1 ]				
	Climate Indicators					[ 27 ]	
	Cryosphere	[ 8 ]	[ 34 ]		[ 1 ]	[ 27 ]	
	Land Surface	[ 5 ]	[ 49 ]		[ 1 ]	[ 27 ]	
	Oceans	[ 22 ]		[ 2 ]		[ 31 ]	
	Spectral / Engineering	[ 10 ]					
	Terrestrial Hydrosphere		[ 2 ]			[ 1 ]	
	Others	[ 2 ]					